In the period of times t221 to t222, when the first switching element 104*b* is normal (when it is normally in OFF state), the connection point voltage V_{CN} is higher or lower than the reference voltage V_{REF} at the same frequency as the first diagnosis voltage and thus the diagnosis result signal CR output from the comparator 107*e* is switched between a high level and a low level at the same frequency as the first diagnosis voltage. That is, when the first switching element 104*b* is normal, an edge is generated in the diagnosis result signal CR.

Subsequently, the CPU 120 switches the first switching element 104*b* to ON state by setting the first control signal CT1 to a high level at time t223, and controls the second switching element 106*a* in a PWM manner by outputting the pulse-like second control signal CT2 with a fixed frequency again in the period of times t224 to t225. Accordingly, in the period of times t224 to t225, similarly to the period of times t221 to t222, the pulse-like first diagnosis voltage with a fixed frequency is supplied from the first diagnosis voltage supply circuit 106 to the control line CL.

In the period of times t224 to t225, when the first switching element 104*b* is normal (when it is normally in ON state), the connection point voltage V_{CN} is normally lower than the reference voltage V_{REF} and thus the diagnosis result signal CR output from the comparator 107*e* is maintained at a high level. That is, when the first switching element 104*b* is normal, no edge is generated in the diagnosis result signal CR.

The CPU 120 determines whether or not the first switching element 104*b* is abnormal based on the edge of the diagnosis result signal CR, which is obtained when turning on and off the first switching element 104*b* while controlling the first diagnosis voltage supply circuit 106 to supply the pulse-like first diagnosis voltage with a fixed frequency to the control line CL as described above.

Specifically, the CPU 120 determines that the first switching element 104*b* is normal when an edge in the diagnosis result signal CR is detected at the time of turning off the first switching element 104*b*, and determines that the first switching element 104*b* is abnormal (on-fixed malfunction) when no edge in the diagnosis result signal CR is detected, while controlling the second switching element 106*a* in a PWM manner.

The CPU 120 determines that the first switching element 104*b* is normal when no edge in the diagnosis result signal CR is detected at the time of turning on the first switching element 104*b*, and determines that the first switching element 104*b* is abnormal (off-fixed malfunction) when an edge in the diagnosis result signal CR is detected, while controlling the second switching element 106*a* in a PWM manner.

Then, the CPU 120 controls the third switching element 109*a* in a PWM manner (where the first switching element 104*b* and the second switching element 106*a* are maintained in OFF state) by outputting the pulse-like third control signal CT3 with a fixed frequency (for example, 2 Hz with a duty ratio of, for example, 50%) after time t226 in FIG. 10B. Accordingly, after time t226, the pulse-like second diagnosis voltage (of which the maximum value is equal to the main source voltage V_{IGB}) with the same frequency and duty ratio as the third control signal CT3 is supplied from the second diagnosis voltage supply circuit 109 to the pilot signal line 34.

After time t226, when the pilot signal line 34 is normal, the connection point voltage V_{CN} is higher or lower than the reference voltage V_{REF} at the same frequency as the second diagnosis voltage and thus the diagnosis result signal CR output from the comparator 107*e* is switched between a high level and a low level at the same frequency as the second diagnosis voltage. That is, when the pilot signal line 34 is normal, an edge is generated in the diagnosis result signal CR.

The CPU 120 determines whether or not the pilot signal line 34 is abnormal based on the edge of the diagnosis result signal CR, which is obtained when controlling the second diagnosis voltage supply circuit 109 to supply the pulse-like second diagnosis voltage with a fixed frequency to the pilot signal line 34 in the state where the first switching element 104*b* is maintained in OFF state as described above.

Specifically, the CPU 120 determines that the pilot signal line 34 is normal when the second diagnosis voltage supply circuit 109 is controlled to supply the second diagnosis voltage of a fixed frequency to the pilot signal line 34 and an edge in the diagnosis result signal CR is detected at that time, and determines that the pilot signal line 34 is abnormal when no edge in the diagnosis result signal CR is detected at that time, in the state where the first switching element 104*b* is maintained in OFF state.

As described above, according to the third embodiment, since it is determined whether or not the first switching element 104*b* is abnormal based on the diagnosis result signal CR which is obtained when turning on and off the first switching element 104*b* of the pilot voltage setting circuit 104 while controlling the first diagnosis voltage supply circuit 106 to supply the first diagnosis voltage to the control line CL, it is possible to diagnose the abnormality of the first switching element 104*b* disposed in the pilot voltage setting circuit 104 used to change the pilot signal CPL in a stepwise manner.

According to the third embodiment, it is determined whether or not the pilot signal line 34 is abnormal based on the diagnosis result signal CR which is obtained when controlling the second diagnosis voltage supply circuit 109 to supply the second diagnosis voltage to the pilot signal line 34 in the state where the first switching element 104*b* is maintained in OFF state. Here, since the abnormality diagnosis circuit 107 outputs the diagnosis result signal CR indicating the abnormality when a disconnection or earth fault is generated in the pilot signal line 34, it is possible to diagnose the abnormality of the pilot signal line 34, such as, for example, the disconnection and earth fault.

What is claimed is:

1. An electronic control unit that is mounted on a vehicle which is configured to be charged with an external power supply and that receives a pilot signal via a charging cable before being supplied with a power when the vehicle is connected to the external power supply via the charging cable, the electronic control unit comprising:

a control line that is connected to a pilot signal line connecting a charging cable connector disposed in the vehicle to the electronic control unit;

a processor that performs a process necessary for a control of charging based on the pilot signal input via the control line;

a pilot voltage setting circuit that is connected between the control line and a ground and that includes a serial circuit of a pull-down resistor and a switching element controlled by the processor;

a voltage supply circuit that includes at least one of a first diagnosis voltage supply circuit supplying a first diagnosis voltage to the control line under control of the processor and a second diagnosis voltage supply circuit supplying a second diagnosis voltage to the pilot signal line via an abnormality diagnosis line connected to the pilot signal line at the charging cable connector under control of the processor; and

an abnormality diagnosis circuit that is connected to the pull-down resistor and the switching element and that